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Portland Cement

STUCCO SURFACING



Concrete for Permanence

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Hollywood Terminal Building, Los Angeles, Calif.

Morgan, Walls & Clements, Architects

AN impressive view of the new \$2,000,000 Hollywood Terminal Building, Los Angeles, showing massive grandeur attained in a commercial structure. This building is fourteen stories in height, built of monolithic concrete, and finished in light grey portland cement stucco. The architectural treatment now being accorded such buildings on the Pacific Coast is exemplified in this edifice.

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STUCCO SURFACING

PORTLAND cement stucco is a slab of concrete, the surface of which has been decoratively treated either by means of troweling or by use of color or by a combination of both. It is a concrete slab designed for use as a permanent coating for outside or inside walls of dwellings and many other buildings.

To understand the subject clearly, it is well to bear in mind that there are "stuccos" made from materials other than portland cement, sand and water. Naturally portland cement stucco is unlike non-concrete stuccos in many respects.

The Characteristics of Portland Cement Stucco

Inasmuch as portland cement stucco is concrete—the material that forms the structural frame of skyscrapers and heavy duty pavements—it has all the characteristic properties of concrete. It is remarkably strong and grows stronger with age. It needs no protecting coat to prevent disintegration by heavy rains beating upon it. On the contrary, water helps portland cement stucco grow stronger. It is impervious to the weather and wholly unaffected by it. It will not rot nor burn.

In addition no chemical reaction occurs between portland cement stucco and the various mineral pigments which may be mixed with it for tintings, nor with the metal reinforcing which strengthens it. Stucco is applied in a plastic state, at which time its surface may be textured to produce practically any architectural feeling. After the texture is made, the stucco hardens, gaining greater strength as time goes on.

What Makes a Good Job

For all these remarkable qualities, portland cement stucco is not expensive. It is made of nothing more than sand, water and cement. Any workman can apply it satisfactorily if he will follow a few simple rules given in this booklet.

Haphazard methods of mixing the cement, sand and water invariably will be followed by unsatisfactory results. Likewise stucco will not stand without damage a movement of the base upon which it has been applied. Unequal settlement of a build-

ing is prevented by proper construction of the footings and foundations.

The procedure given here is indeed simple to follow. Millions of square yards of portland cement stucco which were built in this manner have been standing for years in practically every portion of this country. It represents the result of years of experiments and thorough investigations by such national organizations as the United States Bureau of Standards or the American Concrete Institute whose recommendations have been followed here. The latter is an organization of technical men of the building industry, whose sole objects are to find the best ways to do concrete work and to spread that knowledge.

If we picture stucco applied to a wood framed building, we can see that such construction is truly reinforced concrete, for reinforced concrete is concrete in which steel rods are embedded to increase its strength and the reinforcing mesh or fabric in stucco on a frame house corresponds to these bars of steel. Good reinforced concrete is as strong and permanent as any material known. Therefore it remains only for the home owner or builder to know and apply the few simple rules necessary in the preparation and application of stucco to get lasting and beautiful effects in portland cement stucco.

Good Design Is Necessary

Successful work depends in large measure upon suitable design of the structure upon which stucco is to be placed. Whether this be of ordinary frame construction, or of masonry, which is preferable, the design and construction should be such that the house does not move due to settlement or other causes. Careful design also prevents water from getting behind the stucco, or from staining the surface by running down from the ends of window sills.

When used on frame construction the reinforced concrete principle should be followed. This means that a sheet of metal mesh or wire fabric will be located in the approximate center of the slab of stucco. The all too prevalent practice of "skinning the job" by not thoroughly embedding this rein-



Residence at Great Neck, Long Island, N. Y.

forcement or of putting on thin coats of mortar should not be permitted. The plasterer who follows the specifications and recommendations as given in this booklet, will get a stucco exterior that is durable, fire resistive, waterproof, structurally sound, attractive in appearance, economical in first cost and without maintenance and repair charges.

Texture

A pleasing exterior appearance of a house demands the use of textures and colors which will harmonize with the architectural style as well as with the natural surroundings. Texture in stucco, as referred to here, is the effect gained by working, or applying, the mortar of the finish coat with a trowel or other tools to create various degrees of roughness or design. The variety of textures to be had is limited only by the skill of the plasterer. He may produce a fine, leaflike finish, or a troweled spatter dash finish, or the stucco may be applied in a broad feather-like sweep, producing an attractive irregularity which gives the building that individuality and character which lifts it out of the commonplace. In general, the finer textures will be found to be more suitable for use on the smaller houses, while the heavier textures are adaptable for larger homes,

where at a distance the softer effect of uniformity appears. Various textures are shown and described elsewhere in this booklet.

Color

Color plays an important part in our everyday life. Its use over the past few years, especially as relates to homes, has become so widespread that great interest has been created in the best methods of obtaining enduring colors in desirable shades, with common construction materials. There is probably no material for surfacing walls with which color may be better used than portland cement stucco. If especially selected colored sands and stones cannot be found to give the colors desired in combination with either gray or white portland cement (the latter for obtaining the lighter shades), use should be made of mineral coloring pigments, to be mixed with the materials of the finish coat. Directions as to the use of coloring pigments will be found on page 20 of this booklet.

Prepared Portland Cement Stucco Finishes

Prepared portland cement stucco for the finish coat is an aid in obtaining desired effects in stucco. The manufacturers of such stucco have gone into

the subjects of mixing, coloring and workability of the prepared stucco and have obtained worthy results. They have cooperated in the work being done by the national bodies interested in the betterment of construction materials to such extent that excellent brands of prepared portland cement stucco which meet approved standards are now on the market. One ton of this prepared finish will cover approximately 250 square yards of surface, depending upon the thickness of the finish coat texture. The use of prepared colored finishes is recommended since they assure more thorough mixing, measured proportions and uniform color made with reliable mineral pigments. If prepared portland cement stucco is not available the procedure of mixing the finish coat mortar on the job becomes a matter of experimenting by making small sample panels to find the proper proportions of pigment for any desired tint. In general, machine mixing of the finish coat materials is to be preferred.

The Owner and the Architect

Portland cement stucco is a material on which the owner and the architect easily agree. There have been furnished in this booklet, step-by-step descriptions of how a few textures are created. Many other textures can be described in a similar way. The owner may indicate the color and texture

that he wants, or he can select such a texture and color from sample panels which the architect provides for his client's inspection. The architect knows how to produce the results demanded by the owner. He knows that in selecting portland cement stucco he is using a material of proved and standardized quality, safe against all possible damage in the future due to destructive climatic conditions.

There are certain advantages in using portland cement stucco which appeal particularly to the home owner. Its economy from the standpoint of upkeep is well appreciated. The stucco house needs no paint except on the trim and on this single item alone the owner will find that the money saved in five years will more than pay the difference in first cost between the stuccoed house and the one of less durable construction. There is also a saving on depreciation, and, after a few years a very material saving on the miscellaneous repairs.

Stucco Increases Value

The increased property value which is assured by better appearance is an item more difficult to estimate accurately, but which is just as certain as any other advantage. Homes covered with portland cement stucco, as a rule, increase in value as the years go by because they are permanent in construction and their appearance improves with age. In sub-



Residence at Los Angeles, Calif.

urban communities especially, one beautiful home attracts others of the same type thereby increasing its own value as well as enhancing the real estate values of the community.

When stucco is used in "overcoating" an old house this item becomes a very real factor of increased valuation. A complete rejuvenation is possible if the frame of the old structure is well built.

Stucco Resists Fire

Our national fire loss in 1924 was approximately \$550,000,000. Of this stupendous total \$90,000,000 represents the loss from fire in dwellings alone. This is the price paid in one year for combustible construction in homes. More general use of stucco exteriors and incombustible roof coverings would greatly reduce this dwelling loss, since a quarter of the losses result from exterior sources of fire exposure. In the conflagration which practically destroyed the residence portion of Berkeley, California, in September, 1923, the houses which had exteriors of portland cement stucco appreciably checked the advance of the fire.

That the fire resistance of portland cement stucco is more than ample has been conclusively proved in fire tests of stucco at the Underwriters' Laboratory in Chicago. A one-inch coat of portland cement stucco on metal lath stapled to wood studding withstood the standard temperature test of 1700 degrees Fahrenheit for over an hour, after which the expansion due to the great heat pulled out the staples but left the stucco undamaged. Applied to a concrete block wall a stucco coat was intact after four hours of temperatures ranging from 1700 to 2000 degrees Fahrenheit. The temperatures used in these tests would rarely be reached in ordinary fires.

Cleaning Stucco Surfaces

Portland cement stucco surfaces are not harmed by the application of large quantities of water or of water and cleansing materials, such as soap. In fact, during the early life of the stucco, that is, up to two years, water applied to it is really beneficial. Cleansing operations can be carried on without danger of injuring or softening the stucco. Thorough scrubbing with soap suds, using fibre brushes, usually will remove all dust and smoke stains. A dilute solution of 20 per cent hydrochloric acid may be necessary to clean particularly dirty surfaces. If it is desired to change the color of old stucco, the surface should first be thoroughly cleaned after

which a cement and pigment mixture may be applied as a stain, or it may be given a new stucco finish.

In general there are two classes of stains suitable for concrete or stucco surfaces: those (1) in which the water is mixed with the pigment and cement by the manufacturer, and those (2) which require the addition of water just prior to application. In using the latter stains, which are dependent for their strength and permanence on the combining of the water and the cement care should be taken that sufficient water is present long enough to permit proper hardening of the cement. The practice of thoroughly wetting the concrete or stucco surface just prior to the application of water-tempered cement stains should always be followed. If practicable this new coat of stain should be kept damp for several days after its application.



Transportation Bldg., Los Angeles, Calif.

PUBLIC BUILDINGS FINISHED IN STUCCO

AN appreciation of architectural color in residences has naturally led to the use of stucco for the finish of public buildings.

Stucco has character, beauty and strength. It is not expensive and the substantial foundation and frame usually found in office buildings, clubs, hotels, churches and other public structures guarantee an ideal plastering base for it.

Portland Cement Stucco Is Widely Used

The cheerful appearance of our every day surroundings is something which has been neglected in many cities, but in many others this spirit of worthwhile architectural beauty has been caught and per-

petuated in plastic surfacing. The business sections of cities such as Los Angeles, San Francisco, Portland, Atlantic City and Miami furnish examples. In Los Angeles especially, are seen such stuccoed buildings as the Builders Exchange, Transportation Building, Elks Club, Public Library, Milton-Cooper Store, University Club, St. Vincent's Church and others. The Chronicle Building is a worthy instance of stucco in San Francisco. The Anson Mills Building in El Paso, the Edgewater Beach Hotel, Chicago, the Blatt Department Store in Atlantic City and the Miami-Biltmore Hotel at Miami show that the use of portland cement stucco is not localized in any one portion of the country.

The practice followed on such buildings is no different than that of applying portland cement stucco to the smallest dwelling. The backing materials of such buildings are invariably of masonry, and offer an excellent mechanical hold to the stucco mortar, which in time becomes so hard as to be part of the structure itself. Three coats of stucco are recommended.

The warmer cream or buff colors are generally used to liven the whole appearance and the texture may be of any type in which the true character of the material—concrete—is shown. Concrete cast stone for the trim of the building relieves the general treatment and permits the development of simple or elaborate designs.

Uniform Shade Assured

The increase in the use of prepared portland cement stucco finish coats, pre-mixed in all colors and shipped in bags to the job, has done much to popularize stucco for large building work. A uniformity of shade is required when color is used on such large wall areas and this is very difficult to obtain in hand mixing. Machine preparation guarantees this as well as more thorough mixing in the correct proportions. More detailed information regarding prepared portland cement stucco is given on page 21.

The dollars-and-cents value of the appearance of public buildings is an item being seriously considered in the beautifying of cities today. The owner is coming to realize that it is much easier to rent space in an office building of distinctive appearance.



Hotel Senator, Sacramento, Calif.

The residence of Mr. C. D. Hammond, Maplewood, N. J., is a worthy example of a modern Colonial style in portland cement stucco on concrete block walls. Concrete roofing tile further guarantees the permanence of the house.



Mr. Wm. Lee Woollett, architect of the City Hall in Eagle Rock, a suburb of Los Angeles, Calif., has here used stucco on a reinforced concrete frame. The architectural style is in keeping with Spanish traditions.

The Minshall residence, Chillicothe, Ohio, shows the clean-cut appearance of portland cement stucco. This plain texture with but the simplest ornamentation lends beauty, strength and long life to the house.



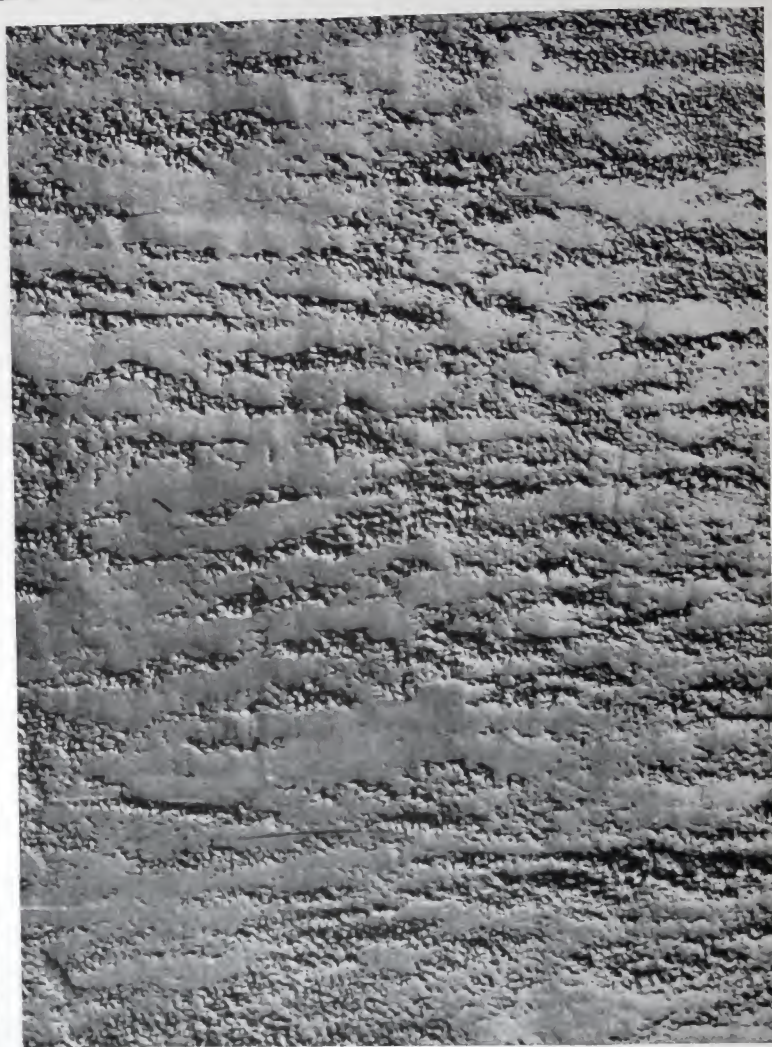
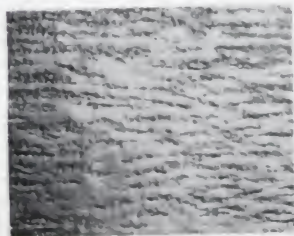
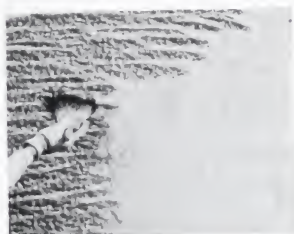


This closeup view of a residence illustrates an ideal textural treatment in stucco. The hard, smooth, but wavy surface, in a light buff color, will easily shed rain, while the textural variations offer opportunity for the play of light and shadow.

The praises of Coral Gables, Fla., have been sung in many ways. One reason is shown in this beautiful home in that city. Portland cement stucco has been used on a large majority of the houses there.



Careful study was given the residence of Mr. Alfred Diffenbaugh, Lancaster, Pa., to incorporate features of early Dutch Colonial style into a thoroughly modern suburban home. The smooth, textured stucco fits admirably into the portrayal of this style.



ITALIAN TRAVERTINE

THIS texture is a representation in portland cement stucco of the appearance of travertine stone. Such marble has been used to decorate the costliest type of interiors. As quarried and cut for use in buildings, the source of the irregularly veined markings in the stone is clearly indicated. These alternate layers of smooth, dense surfaces and fine, thread-like lines have been formed through the centuries by innumerable deposits of hard lime strata interlined with fine cavities. Thousands of years of metamorphism were required to produce these effects.

While Italian in type, the texture will be found to harmonize with various architectural expressions. Many color effects may be fittingly used with this interesting finish. The textural variations are practically unlimited.

HOW TO MAKE THE TRAVERTINE TEXTURE

TO create this texture successfully it is necessary that the finish coat of mortar have good plasticity, as the irregular stippling over any certain area of wall cannot be accomplished in the mortar if it has taken any set.

The second coat, therefore, should be well sprinkled just previous to the application of the finish coat to kill part of the suction of this coat. This prevents the absorption of too much water from the finish coat mortar and permits it to stay plastic for a longer time. Heavy, strong application of the finish coat is advised, of about $\frac{3}{8}$ inch in thickness. It is troweled fairly smooth with a plastering trowel.

The second operation, that of stippling, can best be done with an ordinary whiskbroom, though some effects can better be produced with a bunch of small reeds tied together. The surface should be stippled deeply, with the whiskbroom held at an upward angle to the wall. This pulls up an irregular texture on the surface of the mortar and the ridges are so formed that, when troweled, the holes or depressions do not form pockets for water and dirt.

The stippling should not be too regular in appearance as the spacing and arrangement of the marks of the whiskbroom are to show the irregular markings of the travertine stone which is without any regular lines or design. Practice in holding the

broom and stippling will soon indicate just how this secondary treatment is best done.

The veined markings on the finished surface are the result of troweling the hillocks and hollows of the stippled surface. It can be seen that this is just the reverse of the procedure usually thought of in making this texture—the depressions come first and the smooth spots later, in this case.

The final troweling should occur after an area of wall, perhaps 50 square feet, has been stippled. A certain degree of set is desirable and practice will show just how long a time should pass before troweling is done. Weather conditions have much to do with the rapidity of set of the mortar. On a hot, windy day troweling must be done a shorter time after stippling.

The trowel should be held flat against the wall and the strokes made horizontally. The higher portions of the coat are smoothed down with fairly strong pressure on the trowel to the final surface as shown. Care should be taken to eliminate any trowel marks as the smooth surfaces represent a sawed surface of a block of stone.

The lighter stippling disappears under the troweling, but the lower depressions, however, remain in the finish. It is these markings in combination with the smoothly troweled area that create a very real effect of travertine stone.



Residence of Eugene Munger, Birmingham, Ala.

Warren, Knight and Davis, Architects



MODERN AMERICAN

MODERN tendencies in domestic architecture are so thoroughly diversified in type that it is almost impossible to make a definite selection which will be representative of a majority of the houses seen today. This is quite natural. The Colonial or English types find greatest favor in the East; on the Pacific Coast, the Spanish. In the South, the French or Spanish are shown. In the Middle-West are found examples of what may be called an American architectural style.

This Modern American style has as its basis sound construction and comfortable living quarters, usually for a family of four or more. Goodly porch space, bay windows, considerable window area, moderate roof pitch with wide eaves, and invariably a fireplace and exterior chimney are all marks of this worthy expression.

HOW TO MAKE THE MODERN AMERICAN TEXTURE

THE regular plastering trowel and an ordinary piece of board, perhaps 3 inches by 10 inches in size, are the tools used to produce this interesting texture.

The full depth of finishing coat, of about $\frac{1}{4}$ inch, is applied with the trowel. The mortar should have good plasticity. It is possible to apply a fairly large area of finish coat before dragging the surface with the board, as a certain amount of set is necessary to get the right texture. The surface should be troweled fairly smooth, disregarding slight trowel markings.

Using an upward movement, the board is drawn over the troweled surface while held with a firm grip. A downward stroke in tearing the surface should never be used, as this tends to form minute pockets in the finished texture which easily catch dirt and water. The correct angle at which the board will best tear the surface can be found only by trial.

To tear the troweled surface lightly, the board may be held in one hand; if a heavier texture is desired both hands should be used. The different

holds on the board and positions best suited to create an evenly torn surface, similar to the one shown here, will come with practice. A slight irregularity is usually desirable, but care should be taken to avoid any end marks being left by the board.

The general area of the wall must be fairly even if the texturing is to be done with a board of the size indicated. However, it is possible to get a wavy surface with this texture by simply varying the depth of troweling in certain portions and using a shorter board to tear all the wavy surfaces. While it is possible to show but one texture in the demonstration given here, many variations may be had by varying the troweling, the directions the tearing board moves, the pressure, and the angle.

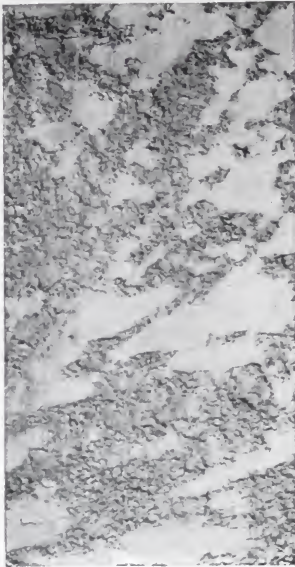
The general effect of this texture is that of tapestry. This effect can be heightened to some extent by means of color. If for instance, the color of the stucco is a buff, a warm, red tint, made of mineral red oxide mixed with cement and water, can be used to tip the higher points of the texture by lightly drawing a brush of this stain over the finished surface.



Residence of Theodore Utz, Larchmont Hills, N. Y.

E. D. Parmalee, Architect

ADDITIONAL PORTLAND CE



ITALIAN

A troweled, spatter dash finish with many variations



ITALIAN BRUSH

A smoother, more carefully finished example of Italian textures



FRENCH

A full, trowel-swept finish emphasizing application



SPANISH

A wavy, trowel-marked finish, smoothly irregular



MOORISH

A surface tooled promiscuously with the rounded corner trowel



GOTHIC

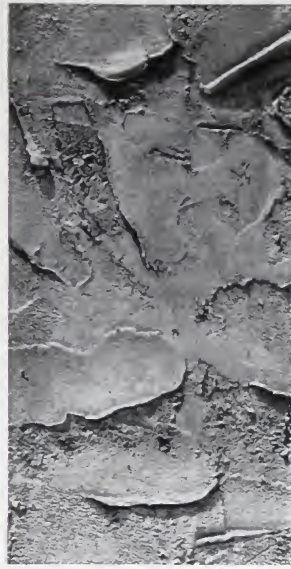
A floated finish rough-torn with the back edge of the trowel

CEMENT STUCCO TEXTURES



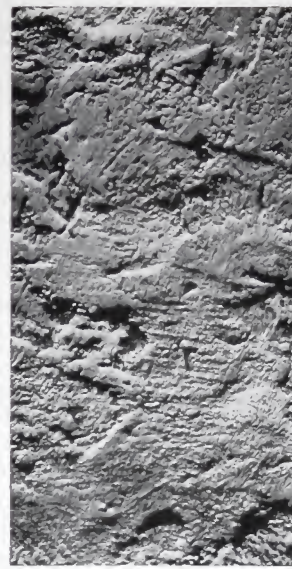
ENGLISH COTTAGE

A fine, leaf-like finish produced by feathering with trowel



ENGLISH

The irregularities are produced by side strokes of the trowel



CALIFORNIAN

A rough cast finish reduced by rubbing with a carpet-covered float



ENGLISH

A soft, heavy texture applied with wood float and brushed



CALIFORNIAN

A finish rubbed with burlap and troweled



**MODERN AMERICAN
STIPPLED**

A smooth surface stippled with a soft, short-bristle brush

PORTLAND CEMENT STUCCO CONDENSED SPECIFICATIONS

GENERAL

Preparation of Surface

1. All hangers, fasteners, trim or other fixed supports or projections of any kind shall be in place previous to the application of stucco. In masonry backing the surface shall be cleaned thoroughly before stucco is applied and shall be sufficiently rough to provide a good mechanical bond for the first coat. (See Recommendations.)

Flashing

2. Flashing shall be in place previous to the application of stucco in the following locations: at the top and along sides of all openings wherever projecting trim occurs; across the wall and under coping, cornices or brick sills with mortar joints, flashing to project beyond upper edge of stucco; under built-in gutters and around roof openings; at the intersection of walls and roofs; and at all other points where flashing would prevent water from getting behind the stucco. (See Recommendations.)

Water Protection

3. All horizontal exposed surfaces, which are of stucco, such as copings, cornices, belt courses, shall be given sufficient fall to prevent water from accumulating on such surfaces. In general, the construction shall protect the surface against excessive concentrated water flow, all horizontal projections being provided with overhanging drips and watertight joints. Stucco wall surfaces shall be stopped 6 inches above grade line. (See Recommendations.)

MATERIALS

Cement

4. Portland cement shall conform to the current standard specifications of the American Society for Testing Materials.

Fine Aggregate

5. Fine aggregate shall consist of clean sand, screenings from crushed stone or pebbles, graded from fine to coarse, passing when dry a No. 4 screen, with not more than 20 per cent through a No. 50 screen, free from dust or other deleterious materials.

Water

6. Water shall be clean, free from oil, acid, strong alkali or vegetable matter.

Coloring Materials

7. Only permanent mineral oxides that are fully guaranteed by the manufacturer to be unaffected by lime, cement or weathering shall be used in coloring. (See page 20.)

Hydrated Lime

8. Hydrated lime shall meet the requirements of the standard specifications of the American Society for Testing Materials and when used shall not exceed one-fifth the volume of the cement.

Reinforcement

9. Reinforcement shall consist either of expanded metal cut from sheets not less than 20 gauge in thickness with openings not less than $\frac{3}{4}$ by 2 inches nor greater than $1\frac{1}{2}$ by 4 inches in size, the fabric to weigh not less than 1.8 pounds per square yard, or wire fabric composed of wires not smaller than 18 gauge used with openings not less than $\frac{3}{4}$ inch square or with wires not smaller than 14 gauge used with openings not greater than 2 inches square. (For use of metal lath as reinforcement see Recommendations.)

CONSTRUCTION

Proportions

10. Mortar for both scratch and brown coats shall be mixed in the proportions of five (5) sacks of portland cement, one (1) fifty-pound sack of hydrated lime and 16 cubic feet of sand. The finish coat, if not a prepared portland cement stucco, shall be of like proportions to those used in the previous coats, with such additions of mineral coloring pigments as necessary, but in quantities not to exceed six per cent of the volume of the cement used. (See Recommendations.)

Mixing

11. Dry mixing of ingredients shall be carried on until the color is uniform; wet mixing until the consistency is uniform. It is positively essential that a definite system be used which shall produce uniform mixes for scratch and brown coats. The quantity of water shall be determined by trial and thereafter used in the proper proportions. (See Recommendations.)

Framing

12. Spacing of studs shall not exceed 16 inches. Studding shall run from foundation to rafters without intervening horizontal members, tied together below 2nd floor joists with 1 by 4-inch boards let into the inner faces of the studs. In open construction without sheathing the spacing of studs shall not exceed 12 inches. The corners of all walls shall be braced diagonally to secure the necessary rigidity of the structure. Bridging of studding with 2 by 4-inch braces shall occur at least once in each story height.

Sheathing

13. Sheathing boards shall not be less than 6 inches, nor more than 8 inches wide, dressed to a uniform thickness, laid horizontally and fastened securely to each stud. Over the sheathing shall be laid, horizontally, beginning at the bottom, any standard asphalt saturated roofing felt weighing 15 pounds per square, the bottom layer lapping the baseboard and each strip lapping the strip below and all flashing at least 2 inches. (See Recommendations.)

Application of Reinforcement

14. Reinforcement shall be placed horizontally, fastened with approved furring devices not more than 8 inches apart over the surface. Vertical laps shall occur at supports, horizontal joints being lapped and tightly laced with 18 gauge annealed wire. The sheets shall be returned around corners at least 4 inches in sheathed construction and 16 inches in open construction. Corner beads shall not be used. (See Recommendations.)

Furring

15. All reinforcement shall be furred out from the studs, sheathing or base $\frac{3}{4}$ inch by any device which will not reduce the effective section of the scratch coat. (See Recommendations.)

Half-Timbering

16. Embedded trim or half-timbering shall be securely nailed directly upon sheathing or studs, and shall have the inside corners of vertical members grooved into which the mortar of the first coat shall be forced forming a watertight joint. All joints on horizontal members shall be flashed.

Masonry Walls

17. Concrete, concrete block, brick, hollow tile and similar walls shall be rigid and constructed upon solid footings, all units being set in portland cement mortar. The surface on which stucco is to be applied shall be clean, free from all dust, dirt or loose particles, preferably rough and of coarse texture. Wood lintels over wall openings shall not be used. Monolithic concrete walls shall be roughened by hacking, wire brushing or other effective means. Concrete block, tile or brick units shall have the joints cut back even with the surface. Clay tile shall be hard burned with dovetail or heavy, ragged scoring. Clay brick walls shall be composed of rough, hard burned clay brick, and if painted or waterproofed shall be covered with reinforcing fabric before overcoating with stucco. (See Recommendations.)

Wetting the Surface

18. Immediately preceding the application of the stucco, the surface of the wall shall be evenly wetted but not saturated. Water shall not be rapidly absorbed from the plaster, nor remain standing on the surface.

Retempering

19. Retempering by the addition of water shall not be permitted.

Consistency

20. Only sufficient water to produce a workable consistency shall be used.

Application of Stucco Coats on Frame Construction

21. The application shall be carried on continuously in one general direction without allowing the stucco to dry at the edges. If it is impossible to work the full width of the wall at one time the joining shall be at some natural division of the surface, such as a window or door. The scratch coat shall be shoved thoroughly through the metal reinforcement forming a solid mass against the sheathing paper, thus completely encasing the metal. This coat shall be $\frac{1}{2}$ inch thick fully covering the face of the reinforcement and shall have its surface heavily cross scratched to provide a strong mechanical key or bond. Allow this coat to become thoroughly dry. It shall be wet down but not saturated before applying the second coat. The second or browning coat shall be at least $\frac{1}{4}$ inch thick over the face of the first coat and shall be rodde straight and true in every direction, or left untrue giving a wavy effect, as the desired finish would suggest. If the finish is to be a float type finish, the second coat shall be brought to a good even surface with wood floats. This coat shall be wet down for at least three days and allowed to become thoroughly dry before the finishing coat is applied. The finish coat shall be applied not less than one week after the application of the second coat and shall vary in thickness from $\frac{3}{4}$ to $\frac{1}{4}$ inch, depending upon the texture of the finish coat. (See Recommendations.)

Scratch Coat on Masonry Walls

22. Mortar shall be troweled on to a thickness of approximately $\frac{1}{2}$ inch, heavily cross scratched and allowed to become thoroughly dry before the browning coat is applied. (From this point on use specification covering "Application of Stucco Coats on Frame Construction." See paragraph 21.)

Freezing

23. Stucco shall not be applied when the temperature is below 32 degrees F., unless protected with canvas and heat sufficient to prevent freezing for a period of at least 48 hours after application.

Curing

24. Each coat shall be protected from drying rapidly from effects of intense sunlight or wind until it has sufficiently hardened to permit sprinkling. Each coat shall be kept moist by sprinkling for at least three days following its application.

Back-Plastered Construction

25. In back-plastered construction, the metal lath shall be attached directly to the face of the studs by an approved furring device and the mortar of the first, or scratch coat applied with sufficient force to push it through the openings of the metal lath forming keys behind. The back-plastering coat shall not be applied until the scratch coat has hardened sufficiently to prevent injuring the keys of the scratch coat. The back-plastered coat shall not be less than $\frac{1}{2}$ inch thick back of reinforcement, composed of the same proportions and materials as the scratch coat and shall be applied from side to side of the hollow space between studs. The application of the browning and finish coats on back-plastered construction is identical with other methods as previously given. (See Recommendations.)

Open Construction

26. In open construction a standard 15-pound asphalt saturated roofing felt shall be applied directly on the outside face of the studs being fastened by flat-headed roofing nails on 12-inch centers. Vertical laps shall be 12 inches and horizontal laps 6 inches over

the lower course. Metal reinforcement shall be applied over the entire surface held in place by approved furring devices, lapping at least 2 inches on all horizontal laps and at least 6 inches on all vertical laps. All horizontal laps between the studding shall have at least one tie with No. 18 annealed wire. All vertical laps shall occur on studding and shall be laced with No. 18 annealed wire. All metal reinforcement shall be returned around corners at least 16 inches. Corner beads will not be permitted.

Finish Coat

27. The finish coat shall be of the color and texture agreed upon by the owner and architect. If prepared portland cement stucco is used it shall be applied according to the manufacturer's specifications. If a field mix is used for the finish coat it shall be applied in accordance with the practice outlined here. In all cases the architect will furnish samples of texture and color which shall be inspected by all bidding contractors. A definite decision shall be arrived at as to color and texture before bids are taken, in order that bidding shall be done intelligently. (See Recommendations.)

RECOMMENDATIONS ON DESIGN AND CONSTRUCTION

Preparation of Backing Surfaces

Successful work depends in large measure upon suitable design of the structure. If the base moves, the additional stress placed in the stucco slab may cause it to crack, even though good construction is used in the slab itself. Without secure and positive anchorage, the stucco slab should not be expected to stand alone. Masonry walls should provide clean, rough surfaces and when evenly wetted but not saturated should also give the proper amount of "suction" to the first coat, which depends for its bond on these conditions being fulfilled. Unequal suction in the first coat because of different degrees of suction possessed by different backing surfaces will tend to follow through successive coats and may change the color in the finish coat.

Chimneys to be stuccoed should have reinforcing fabric properly placed and supported over the surface, and caps with drips extending beyond face of stucco, giving free fall to water shedding.

Shedding of Water Flow

"Keep water from getting behind the stucco" is a fundamental rule. The design should go further than this providing a means for preventing any accumulation of water flow from reaching the stucco surface at all. It is absolutely necessary to see that all molds, caps and sills are provided with drips. The tops of all moldings and other ornamentation should be so made

as to run the water off quickly. It is not necessary to have this fall interfere with the architectural design, but it should be positive.

Flashing

Flashing should be specified whenever there is any doubt as to the waterproofness of a joint. The use of such materials that will not oxidize and stain the stucco, is recommended.

Insulation

Insulation requirements may be met by the application of any satisfactory insulation material, or ordinary building paper in a double layer between the studs.

Sheathing

Diagonal sheathing tends to crack the overlying stucco by setting up strains in the supporting frame, and is also less economical in labor and material than horizontal sheathing.

Furring

The aim in using furring should be to locate and securely fasten the sheet of reinforcement as near the center of the stucco slab as possible without using a type of furring which by its nature would materially decrease the thickness of the slab and cause its cracking. It is suggested that a metal furring nail with metal spacer will answer these requirements satisfactorily.

Reinforcement

The principle to be followed is to create a continuous metal reinforcement over the entire surface to be stuccoed and have this of a character similar to the reinforcing system of reinforced concrete. To meet such a requirement demands that the sheet of metal reinforcement have large enough openings through which the mortar is to be pushed that there will be no difficulty in completely filling the space back of this sheet and completely embedding same.

Metal lath if used as a reinforcement (without back-plastering) should have as large mesh openings as possible, be furred out $\frac{3}{8}$ inch from sheathing and weigh not less than 3.4 pounds per square yard. Special care must be used to completely encase the lath by pushing the mortar through it thus filling the space back of the lath. Unless this is done the intent and purpose of having the lath act strictly as a reinforcement is defeated.

Mixing

The use of a machine mixer is advocated for uniformity of mixing if the work is of sufficient size to warrant its use. Ordinarily a mortar box will suffice. Using a one cubic foot measuring box, measure out 16 cubic feet of sand and mark its level in the mortar box. Fill the mortar box to this mark with sand in succeeding mixes, five sacks of portland cement and one sack of hydrated lime being added.

Proportions

Richer mixtures in the finish coat mortar may be used with the finer finishes, while with coarser textures the standard 1 to 3 proportions of cementing materials to sand should be adhered to.

Application of Stucco Coats

When stuccoing masonry walls the bond between first coat and base surface should be as strong as possible. A correct suction between coats tends to draw the fine particles of cement of the new coat into the pores and interstices of the old, and thus creates a strong bond. The first, or scratch coat, is the most important in giving strength to the slab, the second or brown coat to even out or to produce an undulating surface and the finish to create the texture wished. Two-coat work may be used on a monolithic masonry base, or on a concrete block base, but never should be used on frame with metal reinforcement.

As time is always a factor in any building operation, it is advisable to let the first plastering operation be the application of the sheathing paper, the metal reinforcement and the scratch coat. Then the interior work can be done before the browning coat is applied. This should be allowed to dry thoroughly and all outside cement work completed before the finish coat

is applied. This eliminates the marring of the finish coat and leaves the building clean, also eliminating any loss of time for curing which is so necessary to stucco work.

Back-Plastered Construction

In back-plastering, care should be taken that complete embedment of the reinforcement is accomplished without injury to the first plaster coat already in place. With a total depth of $1\frac{1}{4}$ inches in a back-plastered stucco slab there is no necessity for insulation. The fire protective qualities of back-plastered construction are quite sufficient, especially if metal lath baskets, filled with noncombustible materials, are placed between studs at each floor level, as fire stops.

Hair or Fibre

Hair or fibre should be used only in the first coat of mortar if metal lath is to be back-plastered.

Finishing

The architect should bring to his client's attention the possibilities in portland cement stucco colors and textures as described in this book. In the choice of these, samples may be submitted by competent stucco contractors and in every case a definite sample of texture and color should be furnished by the architect for the basis of bids.

The application of the finish is a distinct craft and the plastering contractor should endeavor to use only experienced workmen to obtain good results. Many variations of color and texture are possible and will produce artistic finishes if the practice suggested here is followed.

Materials Required for 100 Square Feet of Surface for Various Thicknesses of Stucco

THICKNESS	PROPORTIONS			
	1 : 3		1 : 3½	
	Cement (Sacks)	Sand (Cubic Feet)	Cement (Sacks)	Sand (Cubic Feet)
$\frac{1}{8}$ inch	.36	1.10	.33	1.15
$\frac{1}{4}$ inch	.73	2.20	.65	2.29
$\frac{3}{8}$ inch	1.10	3.30	.98	3.44
$\frac{1}{2}$ inch	1.47	4.40	1.31	4.59
$\frac{3}{4}$ inch	2.22	6.60	1.91	6.87
1 inch	2.94	8.80	2.62	9.18
$1\frac{1}{4}$ inches	3.68	11.00	3.28	11.45

These quantities may vary 10 per cent in either direction due to the character of the sand and its moisture content. No allowance is made for waste.

If hydrated lime is used (20 per cent of volume of cement) decrease these quantities 12 per cent.

COLORING MATERIALS

MIXING of mineral coloring pigments with the ingredients of the finish coat should be resorted to on the job only when prepared machine-mixed materials for this coat are not available in the desired colors. Then, if it is desired to add color to the stucco, use should be made of mineral coloring pigments only if it is found that the natural colors of the sand with either grey or white cement do not produce the desired effect.

Mineral colors should be used, as those of an organic or aniline base are likely to fade under the action of the lime in the mortar or, because of inert, non-strength-giving materials being deposited in the mortar, may excessively reduce the strength of the stucco slab.

The finer the coloring materials are ground and the better they are distributed through the mortar, the greater is their ability to impart their color. Another important requirement in a satisfactory pigment is a high tinting value. Although the unit first cost of such pigments will be higher, it is advisable to use them as the least amount of pigment will be required to obtain a definite tint.

Simple tests will readily indicate how well any particular pigment will intimately unite with the cement. These tests may consist of quietly placing a small quantity of the powdered pigment in a glass

of water and watching its settlement, or in making a thin wash mixture with neat portland cement, allowing it to stand and then observing if separation of the pigment particles from the cement occurs. Additions of most inert admixtures somewhat reduce the strength of the stucco, but not appreciably unless the amounts added are large. In general, it will be found that additions of coloring material not greater than six per cent of the weight of the cement will be sufficient to produce most tints.

It is practically impossible to arrive at definite color formulæ applying to the use of coloring materials since the variations in the colors of the sands used as well as in the pigments themselves would make such formulæ but approximations. Best results are obtained by experiment or trial. Small panels should be made, using different percentages of pigment with uniform methods of mixing. For the lighter tints the use of white portland cement in the finish coat is convenient.

A general guide to the selection of coloring materials to obtain various tints in stucco follows: Reds and Pinks—Red Oxide of Iron; Yellows and Buffs—Yellow Oxide of Iron; Greens—Chromium Oxide; Browns—Brown Oxide of Iron; Blues—Ultramarine Blue; Greys or Slate—Manganese Black, Drop Black, or Germantown Lampblack.



Edgewater Beach Hotel, Chicago, Ill.

PREPARED PORTLAND CEMENT STUCCO

THE principles underlying the preparation, proportioning, mixing and application of portland cement stucco are very simple and can be easily understood by the average plasterer.

However, a more uniformly good quality of stucco would undoubtedly result if the materials came to the job either completely mixed ready for the addition of water, or if they were available to the plasterer in properly proportioned packages. Finishes involving definite and controlled color effects could be popularized and developed more easily if the materials were prepared in a plant under expert supervision. This would give the advantage of factory measured and proportioned materials, machine mixing, grinding of the coloring pigment with the cement and selected materials.

Some shades of stucco require the use of as many as four different pigments which could be combined only with difficulty on the job. By automatic measuring and weighing, every batch of stucco of any one color can be made exactly like every other batch, thus assuring the uniformity desired in good practice. The right amount of sand could be added as well, so that when the stucco is delivered at the job it is only necessary to add water and use.

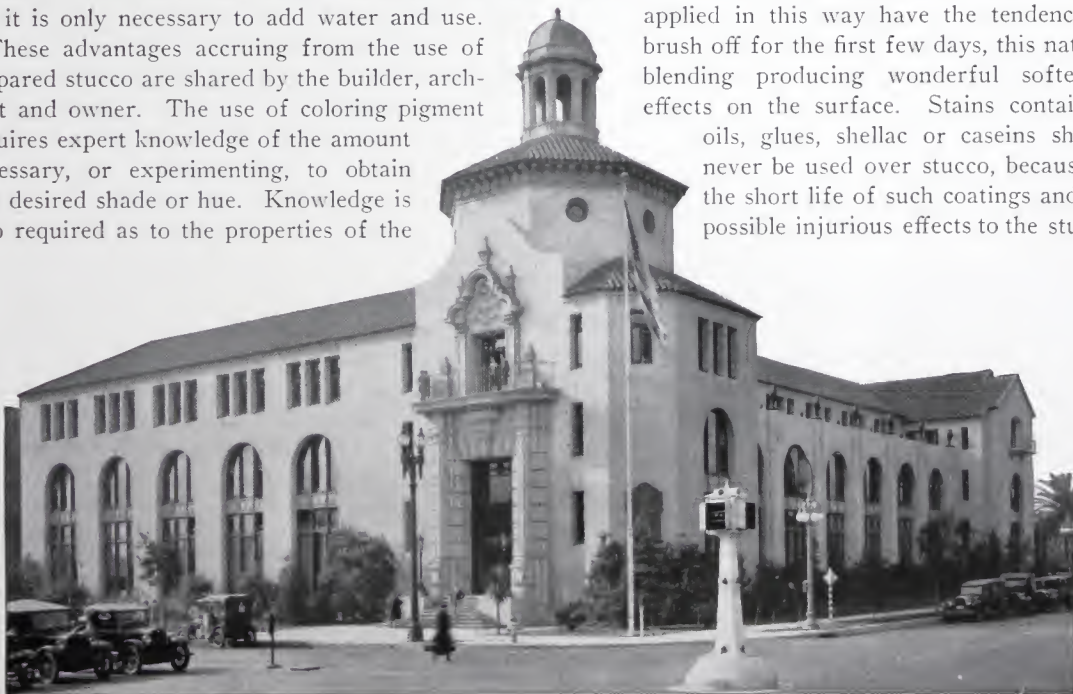
These advantages accruing from the use of prepared stucco are shared by the builder, architect and owner. The use of coloring pigment requires expert knowledge of the amount necessary, or experimenting, to obtain any desired shade or hue. Knowledge is also required as to the properties of the

various pigments that make them suitable for specific uses.

Continual experiment and research work on the part of several reputable manufacturers of colored portland cement stucco have shown that only the highest grade of mineral pigments should be mixed with cement if fading is to be avoided. Builders have previously been under the necessity of trusting to the care of the mortar mixer at the job for results. Carelessness on his part or failure on the part of the contractor to buy the proper pigments would result in a faded stucco or one which dried out to several different shades.

The experience of manufacturers has shown that best results are obtained by mixing the cement and pigment together for a longer time and more thoroughly than is possible on the job.

Some manufacturers of prepared stuccos now have available mixtures of coloring pigment and cement, in the right proportions, which have been re-ground together in machines. These are furnished in suitable containers for use on the job and it is only necessary to add water and apply the mixture as stains on the finished texture. Stains applied in this way have the tendency to brush off for the first few days, this natural blending producing wonderful softening effects on the surface. Stains containing oils, glues, shellac or caseins should never be used over stucco, because of the short life of such coatings and the possible injurious effects to the stucco.



Los Angeles Automobile Club, Los Angeles, Calif.

OVERCOATING OLD HOUSES WITH PORTLAND CEMENT STUCCO

*(Before Overcoating)**(After Overcoating)*

RESIDENCE AT PHILADELPHIA, PA.

“OVERCOATING” is the term generally applied to the method of using portland cement stucco as a covering for the exterior surfaces of old houses. The structural framework of such houses invariably still possesses useful life, usually being built of staunch, seasoned timber.

The problem which this rejuvenation process solves is how to preserve and utilize the value of this worthwhile structure, while eliminating the dilapidated appearance of the old exterior and creating a new value of appearance and utility in keeping with more modern ideas and architectural styles. Coincident with the overcoating work, alterations can be made eliminating or changing any undesirable architectural features of the house. When the work is finished, in place of the antiquated structure there is a house of modern appearance, still containing, however, the sound timbers and workmanship of the past. Final settlement of the foundations has also occurred, so that it is reasonable to assume that in the future there will be no further unsightly cracking on walls or ceilings.

The preparation of the surface of the old wall to receive the stucco overcoat requires but a minimum of treatment. In adding an inch or more of stucco to this surface it is of course necessary that all the original projections or trim, such as windows and door frames, be extended or built out proportionately to this depth.

The majority of houses which are overcoated are of frame construction with siding boards. After the extension of the trim a layer of a substantial, waterproof building paper should be applied directly on the siding, which should be renailed if found loose. The sheet of reinforcement is attached over this paper, being furred out $\frac{3}{8}$ inch, so that it will be in the approximate center of the stucco slab to insure its positive and complete embedment in the mortar. Care should be taken to force the scratch coat mortar through the openings of the reinforcement and completely fill the space back of it. From this point on, completing the stucco overcoat follows the standard practice outlined in this book.

When the old surface is of masonry it should be sufficiently rough to give the first coat of mortar a good mechanical bond. If the wall is painted or otherwise glazed, reinforcement should be fastened over it and standard procedure followed.

The advantages of overcoating an old house with portland cement stucco may be summarized as follows: Increased property value is assured by better appearance; upkeep in painting and repairing has been cut to an insignificant item; the house has been thoroughly insulated against temperature changes; for this same reason there is a decided saving in the cost of heating; encased as it is in this “concrete overcoat,” the fire-safety of the structure is apparent.



(Before Overcoating)

THE CHETOPA APARTMENTS, PORTLAND, OREG.



(After Overcoating)

The apartment building pictured above had, after years of useful life, finally reached a state where its dilapidated appearance seriously interfered with its rent-producing capacity. New buildings on all sides were attracting tenants mainly on account of the better appearance of such buildings. The construction of the Chetopa Apartments was sound and the general architecture good. How its owner solved his problem by overcoating with portland cement stucco is well illustrated in the adjoining picture. The cost of gaining such vastly improved appearance was a negligible item, completely absorbed in less than two years.

Below is shown a picture of a church in Englewood, N. Y., after it had received its new overcoat of portland cement stucco. A comparison of this neat, trim appearance with the past appearance of the church is convincing. With practically no alteration expense, as the architectural design had been satisfactory, this revitalization of an old, but well-built structure, had quickly and economically been accomplished. There is no old building today, whose structural frame is in good shape, that it will not profit, both commercially and æsthetically, to overcoat with portland cement stucco of suitable color and texture.



(Before Overcoating)

FIRST CHURCH OF CHRIST, SCIENTIST, ENGLEWOOD, N. J.



(After Overcoating)

EXPOSED AGGREGATE SURFACING

COLOR and textured effects in stucco can be obtained in another way than by the use of coloring pigments. This is by exposing the aggregate, consisting of the fine crushed stone or pebbles, on the surface of the stucco by washing the face of the wall before it has completely hardened.

This method may be described briefly as follows: A careful selection is first made of the aggregate on the basis of its size, grading and integral color. It should be graded from $\frac{1}{8}$ inch to $\frac{1}{4}$ inch in size, and in no case should stone particles over $\frac{3}{8}$ inch in size be used in the stucco. These aggregates are

If the stucco has already hardened, it may be necessary to use a 10 per cent solution of muriatic acid in place of the water alone, to aid in removing the cement coating. All traces of the acid should be removed immediately after scrubbing, by spraying the surface with water from a hose, and the wall should be cured by frequent sprinkling for several days following its application.

Careful proportioning, mixing and placing will go far in getting worthwhile results in textures, and a great variety of colors are to be had in using



The Parthenon, Nashville, Tenn.

thoroughly mixed into the mortar of cement and water, in the usual proportions, and applied on the second, or browning coat to a depth of about $\frac{1}{4}$ inch with the trowel in the usual manner. An even, but not necessarily smooth surface is produced and allowed to set.

After 24 hours, before complete hardening has occurred, the surface cement coating on the particles of aggregate is washed off by using a spray of water from a hose and a stiff bristle brush in scrubbing the surface. This exposes the particles of stone in a fairly uniform way, each one adding its minute spot of color and texture to the whole, thus producing beautiful effects on the surface.

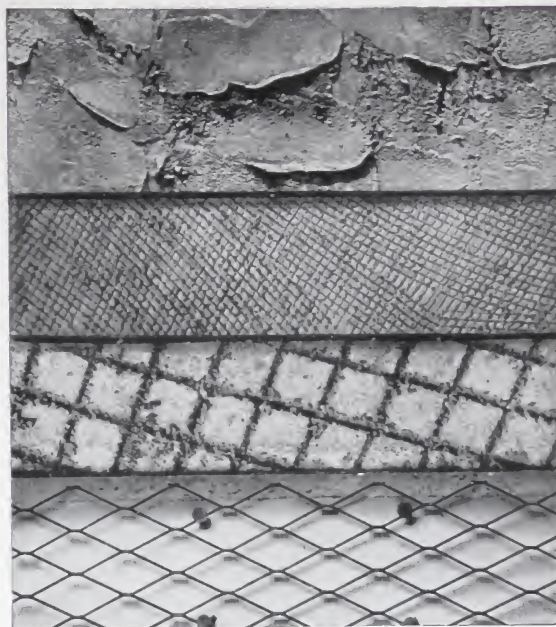
various aggregates, such as quartz, colored granites, feldspar and many other stones. The selection is not limited to any local products, as there are firms who market aggregates of all kinds, shipping the materials in bags direct to the job.

This method of surfacing has been used for finishing many buildings throughout the country, as well as monuments and other architectural decorations in concrete. Among the noteworthy examples may be cited the replica of the Athenian Parthenon, at Nashville, Tenn., the Stadium of the City of Chicago, and the buildings of the University of Louisiana, at Baton Rouge, La.

SOME DETAILS OF STUCCO APPLICATION

**Portland Cement Stucco on Concrete Block**

On masonry construction, if the base is smoothly laid up, two coats are sufficient, but each should be $\frac{1}{2}$ -inch thick. If different masonry materials are used in the same wall, as in clay brick with cement-lime joints, three coats will be necessary. All masonry backing should have the joints cut back even with the surface. If masonry surfaces are painted or waterproofed, they should be covered with reinforcing fabric before the first, or scratch coat of stucco is applied.

**Portland Cement Stucco on Frame Construction**

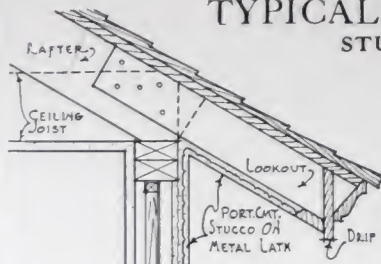
Three coats of stucco should always be used on frame construction. The first coat forms the slab of strength, completely embedding the metal reinforcement. It should be struck off over the sheet of reinforcing, which, if properly furred out $\frac{3}{8}$ inch, will give a first coat thickness of approximately $\frac{1}{2}$ inch. The second coat builds up the thickness and produces an even surface for the finishing coat. The last coat decoratively finishes and seals the surface.

Furring Nails

At the left is shown a close-up of a furring device that fulfills the requirements of proper furring. On the right is shown how the device is used. The upper nail, with the thin, narrow, steel spacer and metal reinforcement in place, is ready to be driven into the sheathing. The lower nail shows how the spacer securely locks the metal reinforcement $\frac{3}{8}$ inch out from the sheathing. The furring should be of a type which does not decrease the effective thickness of the stucco slab.



TYPICAL CONSTRUCTION DETAILS STUCCO ON FRAME CONSTRUCTION



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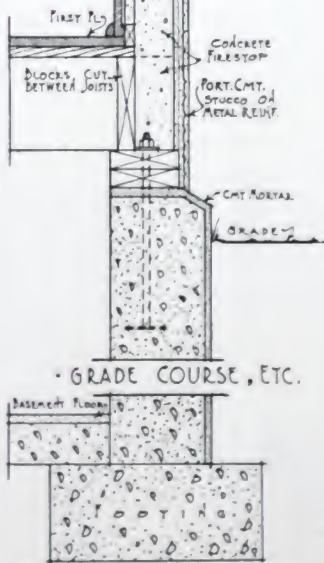
METAL FLASHING
DRIP

• WINDOW HEAD •

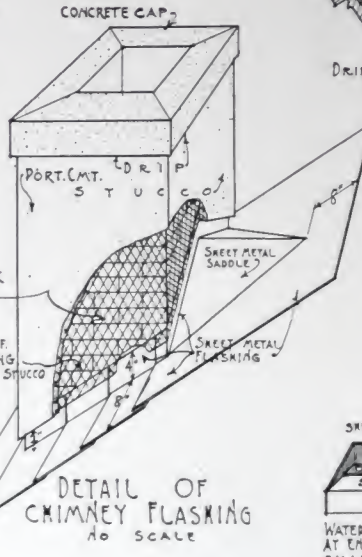
• WINDOW JAMB •

DRIP
PORT. CMT. STUCCO ON METAL REINF.
BACKPLASTER
1" AIR SPACE
2" STUDS @ 12" CTRS.
LATH & PLASTER
INSULATION

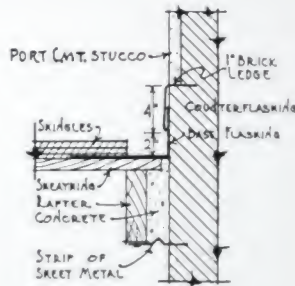
• WINDOW SILL •



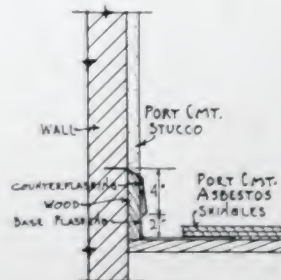
• BACKPLASTERED FRAME •



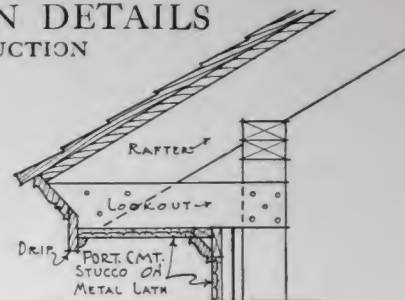
DETAIL OF CHIMNEY FLASHING
No SCALE



• ALTERNATE DETAIL -
• FOR CHIMNEY FLASHING -
• USING COUNTERFLASHING •



• METHOD OF FLASHING •
• ROOFS AGAINST WALLS •
• DORMER CREEKS, ETC. •



• E A V E •

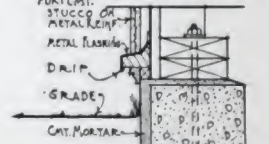
METAL FLASHING
WATER STOP
DRIP

• WINDOW HEAD •

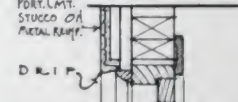
• WINDOW JAMB •

WATER STOP
DRIP
PORT. CMT. STUCCO ON METAL REINF.
FLASHING STRIPS @ 12" CTRS.
WATERPROOF BLDG. PAPER
STUDS @ 12" CTRS.
LATH & PLASTER
HORIZONTAL SHEATHING (NOT DIAGONAL)

• WINDOW SILL •



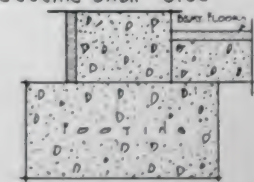
• GRADE COURSE •



• CELLAR SASH HEAD •



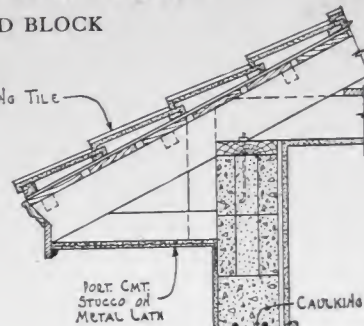
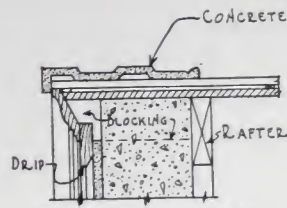
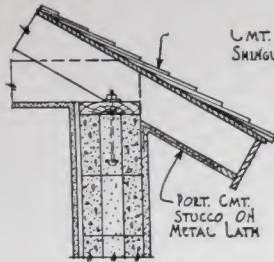
• CELLAR SASH SILL •



• SHEATHED FRAME •

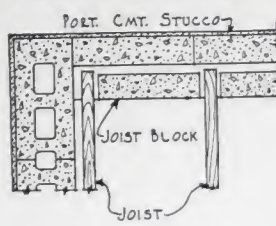
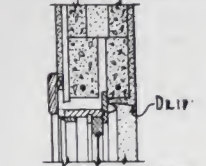
TYPICAL CONSTRUCTION DETAILS

STUCCO ON CONCRETE TILE AND BLOCK

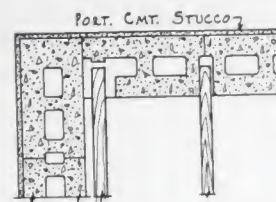
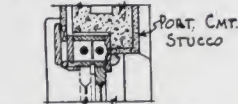


• E A V E •

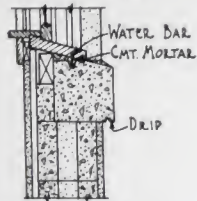
• FLUSH GABLE •



• WINDOW HEAD •

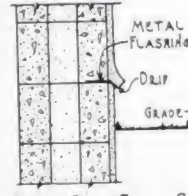
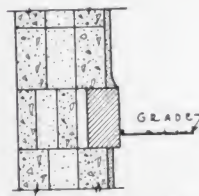
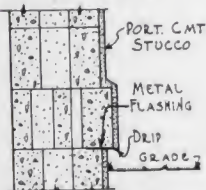


• WINDOW JAMB •



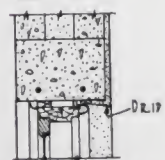
DETAILS OF JOIST BEARINGS

• WINDOW SILL •



• G R A D E •

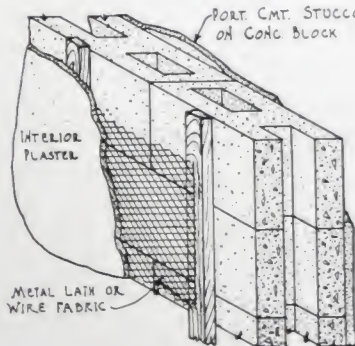
• C O U R S E S •



• CELLAR SASH HEAD •



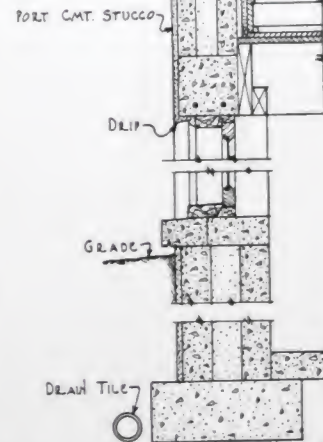
• CELLAR SASH SILL •



FURRING DETAIL

WALL SECTION

• CONCRETE BLOCK DETAILS •



WALL SECTION

Mayflower.
Artstone.
California.

Concrete Masonry Construction



SUMMARY OF CONTENTS

- I General characteristics of concrete masonry.
- II Details of concrete masonry construction. Concrete floors for residences.
- III Specifications for portland cement stucco. Specifications for concrete block and tile and for concrete brick.
- IV Recommended Building Code for concrete masonry construction of the Building Code Committee of the U. S. Bureau of Standards.
Table of weights for concrete block, also standard sizes as recommended by the Division of Simplified Practice, United States Department of Commerce.
Typical calculation for wall footings.
Construction notes on reinforced concrete floors for residences

This booklet presents methods that architects, contractors and builders are successfully employing in concrete masonry construction.

Use the information as a safe guide to sturdy and economical construction with concrete masonry.

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